CLAIMS

1. A method of writing and erasing optical data comprising:

— producing a beam of focusable, coherent light;

focussing the beam on a photorefractive polymeric material to cause two-photon excitation of the material at the focal point of the beam thereby modulating the refractive index at the focal point to record data; and

illuminating the material with radiation to erase the recorded data.

2. A method of writing and re-writing optical data in a photorefractive polymeric material comprising:

focussing a beam of coherent light on the photorefractive polymeric material to cause two-photon excitation of the material at the focal point of the beam thereby modulating the refractive index at the focal point to write data;

illuminating the material with radiation to erase the recorded data;

focussing another beam of coherent light on the photorefractive polymeric material to cause two-photon excitation of the material at the focal point of the beam thereby modulating the refractive index at the focal point to re-write data in the photorefractive polymeric material.

3. A method according to claim 1 or claim 2 wherein the photorefractive material is illuminated with electro-magnetic radiation having a wavelength in the ultraviolet (UV) or visible spectrum to produce a redistribution of the spacial distribution of the electric charges forming bits of the data to erase the recorded data.

4. A method according to claim 3 wherein the photorefractive polymeric material is such that it absorbs radiation in only a narrow band in the UV to visible region of the electromagnetic spectrum.

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5. A method according to claim 3 or claim 4 wherein the maximum of the absorption band of the photorefractive polymeric material falls substantially within the range from about 380nm to about 600 nm.

6. A method according to any one of claims 3 to 5 wherein the photorefractive polymeric material is such that is absorbs substantially no radiation above a wavelength of about 630 nm.

7. A method according to any one the preceding claims wherein the data recorded in the photorefractive polymeric material is read by illuminating the photorefractive polymeric material with coherent light of a wavelength falling substantially within the range from about 630 nm to about 1200 nm.

8. A method according to any one of the preceding claims wherein the beam of focusable coherent light used to record data in the photorefractive material has a wavelength falling substantially within the range from about 750nm to about 1200 nm to cause two-photon excitation.

9. A method according to any one of the preceding claims wherein a pulsed laser beam is used to record data in the photorefractive polymeric material.

10. A method according to any one of claims 1 to 8 wherein a continuous wave laser beam is used to record data in the photorefractive polymeric material.

11. A method according to any one of the preceding claims wherein a polarised beam of focusable, coherent light is used to record polarised bits of data in the photorefractive polymeric material.

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12. A method according to claim 11 wherein different polarisation states of the recording beam are used to record multiple bits of data at the same position having different polarisation states in the photorefractive polymeric material.

13. A method according to claim 11 or claim 12 wherein bits of recorded data are read by using a reading beam having an appropriate polarisation state.

14. A method according to any one of claims 11 to 13 wherein individual bits of data are erasable by changing the polarisation state of the individual bits.

15. A method according to any one of the preceding claims wherein the photorefractive polymeric material includes at least about 25% of a polymer by percentage weight of the total weight of the photorefractive material.

16. A method according to any one of the preceding claims, wherein the photorefractive polymeric material includes a chromophore which provides absorption in the UV to visible region of the electromagnetic spectrum.

17. A method according to any one of the preceding claims wherein the photorefractive polymeric material includes a photosensitive material which provides absorption in the UV to visible region of the electromagnetic spectrum.

18. A method according to any one of the preceding claims wherein the photorefractive polymeric material includs a plasticiser to reduce the glass transition temperature of the material.

19. A method according to any one of the preceding claims wherein the photorefractive material includes at least some of the following materials in quantities falling substantially within the following ranges by percentage of the total weight of the photorefractive material:

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25% - 100% of a polymer ;

0%-60% of a chromophore;

— 0%-5% of a photosensitive material; and

0% - 40% of a plasticiser.

20. A method according to claim 15 or claim 19 wherein the polymer comprises poly (*N*-vinylcarbazole) (PVK).

21. A method according to claim 15 or claim 19 wherein the polymer comprises poly (methyl methacrylate) (PMMA).

22. A method according to claim 16 or any one of claims 19 to 21 wherein the chromophore comprises 2, 5- dimethyl – 4 – (p-nitro-phenylazo) anisole (DMNPAA).

23. A method according to claim 17 or any one of claims 19 to 22 wherein the photosensitive material comprises 2, 4, 7-trinitro-9-fluorenone (TNF).

24. A method according to any one of claims 19 to 23 wherein the plasticizer comprises *N*-ethylcarbazole (ECZ).

25. A photorefractive polymeric material for use in a method of erasable optical data storage, the photorefractive polymeric material providing absorption in the UV to visible region of the electromagnetic spectrum, wherein the absorption band of the phtotrefractive material is such as to enable the recording of bits of data by two photon exciation, the reading of the bits of data by a source of coherent light on the edge of or outside the absorption band, and the erasing of the bits of data by illumination with radiation within the absorption band.

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26. A photorefractive polymeric material according to claim 25 wherein the maximum of the absorption band of the photorefractive material falls substantially within the range from about 380 nm to about 600 nm.

27. A photorefractive polymeric material according to claim 25 or claim 26 wherein the upper end of the absorption band of the photorefractive polymeric material is about 630 nm.

28. A photorefractive polymeric material according to any one of claims 25 to 27 wherein the material includes at least about 25% of a polymer by percentage weight of the total weight of the photorefractive material.

29. A photorefractive polymeric material according to any one of claims 25 to 28 wherein the material includes a chromophore which provides absorption in the UV to visible region of the electromagnetic spectrum.

30. A photorefractive polymeric material according to claim 29 wherein the chromophore is present by an amount falling substantially within the range from about 0.5% to about 60% by percentage weight of the total weight of the material.

31. A photorefractive polymeric material according to any one of claims 25 to 30 wherein the material includes a photosensitive material which provides absorption in the UV to visible region of the electromagnetic spectrum.

32. A photorefractive polymeric material according to claim 31 wherein the photosensitive material is present by an amount falling substantially within the range from about 0.5% to about 5% by percentage weight of the total weight of the photosensitive material.

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33. A photorefractive polymeric material according to any one of claims 25 to 32 wherein the material includes a plasticiser to reduce the glass transition temperature of the material.

34. A photorefractive polymeric material according to claim 33 wherein the plasticizer is present by an amount falling substantially within the range from 0% to about 40% by percentage weight of the total weight of the photorefractive polymeric material.

35. A photorefractive polymeric material for use in a method of optical data storage, wherein the material includes at least some of the following materials in quantities falling substantially within the following ranges by percentage of the total weight of the photorefractive polymeric material;

25% - 99.5% of a polymer;
0% - 60% of a chromophore;
0% - 5% of a photosensitive material; and
0% - 40% of a plasticiser.

36. A photorefractive polymeric material according to claim 28 or claim 35 wherein the polymer comprises poly (*N*-vinylcarbazole) (PVK).

37. A photorefractive polymeric material according to claim 28 or claim 35 wherein the polymer comprises poly (methyl methacrylate) (PMMA).

38. A photorefractive polymeric material according to any one of claims 29, 30 or 35 to 37 wherein the chromophore comprises 2,5-dimethyl-4-(p-nitro phenylazo) anisole (DMNPAA).

39. A photorefractive polymeric material according to any one of claims 31, 32, or 35 to 38 wherein the photosensitive material comprises 2, 4, 7-trinitro–9-fluorenone (TNF).

40. A photorefractive polymeric material according to any one of claims 33 to 39 wherein the plasticiser comprises *N*-ethylcarbazole (ECZ).

41. A photorefractive polymeric material for use in a method of optical data storage comprising the following materials:

poly(*N*-vinylcarbazole) (PVK);
2,5, dimethyl-4-(p-nitrophenylazo) anisole (DMNPAA)
2,4,7-trinitro-9-fluorenone (TNF); and
N-ethylcarbazole (ECZ).

42. A photorefractive material according to claim 41 wherein the PVK;DMNPAA;TNF and ECZ are present in approximately the following concentrations by percentage weight of the total weight of the photorefractive material 33:50:1:16.

43. A photorefractive polymeric material for use in a method of optical data storage comprising the following materials:

poly (methyl methacrylate) (PMMA);
2, 5, dimethyl-4-(p-nitrophenylazo) anisole (DMNPAA);
2,4,7-trinitro-9-fluorenone (TNF); and
N-ethylcarbazole (ECZ).

44. A photorefractive polymeric material according to claim 43 wherein the PMMA: DMNPAA; TNF and ECZ are present in approximately the following concentrations by percentage weight of the total weight of the photorefractive polymeric material 73:10:1:16

AMENDED CLAIMS

[received by the International Bureau on 23 June 2000 (23.06.00);
original claims 1 – 44 replaced by new claims 1 – 45 (8 pages)]

1. A method of writing and erasing optical data comprising:

focussing light on a photorefractive polymeric material to cause two-photon excitation of the material at the focal point thereby modulating the refractive index at the focal point to record data; and

illuminating the material with radiation to erase the recorded data.

2. A method of writing and re-writing optical data in a photorefractive polymeric material comprising:

focussing light on the photorefractive polymeric material to cause two-photon excitation of the material at the focal point of the beam thereby modulating the refractive index at the focal point to write data;

illuminating the material with radiation to erase the recorded data;

focussing light on the photorefractive polymeric material to cause two-photon excitation of the material at the focal point thereby modulating the refractive index at the focal point to re-write data in the photorefractive polymeric material.

3. A method according to claim 1 or claim 2 wherein the modulation of the refractive index caused by the two-photon excitation is a refractive index inhomogeneity resulting from a non-uniform space-charge distribution within the region of excitation within the photorefractive polymeric material.

4. A method according to any one of claims 1 to 3 wherein the photorefractive material is illuminated with electro-magnetic radiation having a wavelength in the ultraviolet (UV) or visible spectrum to produce a redistribution of the spacial distribution of the electric charges forming bits of the data to erase the recorded data.

5. A method according to claim 4 wherein the photorefractive polymeric material is such that it absorbs radiation in only a narrow band in the UV to visible region of the electromagnetic spectrum.

6. A method according to claim 4 or claim 5 wherein the maximum of the absorption band of the photorefractive polymeric material falls substantially within the range from about 380nm to about 600 nm.

7. A method according to any one of claims 4 to 6 wherein the photorefractive polymeric material is such that is absorbs substantially no radiation above a wavelength of about 630 nm.

8. A method according to any one the preceding claims wherein the data recorded in the photorefractive polymeric material is read by illuminating the photorefractive polymeric material with coherent light of a wavelength falling substantially within the range from about 630 nm to about 1200 nm.

9. A method according to any one of the preceding claims wherein the light used to record data in the photorefractive material has a wavelength falling substantially within the range from about 750nm to about 1200 nm to cause two-photon excitation.

10. A method according to any one of the preceding claims wherein a pulsed laser beam is used to record data in the photorefractive polymeric material.

11. A method according to any one of claims 1 to 9 wherein a continuous wave laser beam is used to record data in the photorefractive polymeric material.

12. A method according to any one of the preceding claims wherein polarised coherent light is used to record polarised bits of data in the photorefractive polymeric material.

13. A method according to claim 12 wherein different polarisation states of the recording beam are used to record multiple bits of data at the same position having different polarisation states in the photorefractive polymeric material.

14. A method according to claim 12 or claim 13 wherein bits of recorded data are read by using a reading beam having an appropriate polarisation state.

15. A method according to any one of claims 12 to 14 wherein individual bits of data are erasable by changing the polarisation state of the individual bits.

16. A method according to any one of the preceding claims wherein the photorefractive polymeric material includes at least about 25% of a polymer by percentage weight of the total weight of the photorefractive material.

17. A method according to any one of the preceding claims, wherein the photorefractive polymeric material includes a chromophore which provides absorption in the UV to visible region of the electromagnetic spectrum.

18. A method according to any one of the preceding claims wherein the photorefractive polymeric material includes a photosensitive material which provides absorption in the UV to visible region of the electromagnetic spectrum.

19. A method according to any one of the preceding claims wherein the photorefractive polymeric material includs a plasticiser to reduce the glass transition temperature of the material.

20. A method according to any one of the preceding claims wherein the photorefractive material includes at least some of the following materials in quantities falling substantially within the following ranges by percentage of the total weight of the photorefractive material:

25% - 100% of a polymer ;
0%-60% of a chromophore;
0%-5% of a photosensitive material; and
0% - 40% of a plasticiser.

21. A method according to claim 16 or claim 20 wherein the polymer comprises poly (*N*-vinylcarbazole) (PVK).

22. A method according to claim 16 or claim 20 wherein the polymer comprises poly (methyl methacrylate) (PMMA).

23. A method according to claim 17 or any one of claims 20 to 22 wherein the chromophore comprises 2, 5- dimethyl – 4 – (p-nitro-phenylazo) anisole (DMNPAA).

24. A method according to claim 18 or any one of claims 20 to 22 wherein the photosensitive material comprises 2, 4, 7-trinitro-9-fluorenone (TNF).

25. A method according to any one of claims 20 to 24 wherein the plasticizer comprises *N*-ethylcarbazole (ECZ).

26. A photorefractive polymeric material for use in a method of erasable optical data storage, the photorefractive polymeric material providing absorption in the UV to visible region of the electromagnetic spectrum, wherein the absorption band of the phtotrefractive material is such as to enable the recording of bits of data by two photon exciation, the reading of the bits of data

by a source of coherent light on the edge of or outside the absorption band, and the erasing of the bits of data by illumination with radiation within the absorption band.

27. A photorefractive polymeric material according to claim 26 wherein the maximum of the absorption band of the photorefractive material falls substantially within the range from about 380 nm to about 600 nm.

28. A photorefractive polymeric material according to claim 26 or claim 27 wherein the upper end of the absorption band of the photorefractive polymeric material is about 630 nm.

29. A photorefractive polymeric material according to any one of claims 26 to 28 wherein the material includes at least about 25% of a polymer by percentage weight of the total weight of the photorefractive material.

30. A photorefractive polymeric material according to any one of claims 26 to 29 wherein the material includes a chromophore which provides absorption in the UV to visible region of the electromagnetic spectrum.

31. A photorefractive polymeric material according to claim 30 wherein the chromophore is present by an amount falling substantially within the range from about 0.5% to about 60% by percentage weight of the total weight of the material.

32. A photorefractive polymeric material according to any one of claims 26 to 31 wherein the material includes a photosensitive material which provides absorption in the UV to visible region of the electromagnetic spectrum.

33. A photorefractive polymeric material according to claim 32 wherein the photosensitive material is present by an amount falling substantially within the

range from about 0.5% to about 5% by percentage weight of the total weight of the photosensitive material.

34. A photorefractive polymeric material according to any one of claims 26 to 33 wherein the material includes a plasticiser to reduce the glass transition temperature of the material.

35. A photorefractive polymeric material according to claim 33 wherein the plasticizer is present by an amount falling substantially within the range from 0% to about 40% by percentage weight of the total weight of the photorefractive polymeric material.

36. A photorefractive polymeric material for use in a method of erasable/rewritable optical data storage, wherein the material includes at least some of the following materials in quantities falling substantially within the following ranges by percentage of the total weight of the photorefractive polymeric material;

25% - 100% of a polymer;
0% - 60% of a chromophore;
0% - 5% of a photosensitive material; and
0% - 40% of a plasticiser.

37. A photorefractive polymeric material according to claim 29 or claim 36 wherein the polymer comprises poly (*N*-vinylcarbazole) (PVK).

38. A photorefractive polymeric material according to claim 29 or claim 36 wherein the polymer comprises poly (methyl methacrylate) (PMMA).

39. A photorefractive polymeric material according to any one of claims 30, 31 or 36 to 38 wherein the chromophore comprises 2,5-dimethyl-4-(p-nitro phenylazo) anisole (DMNPAA).

40. A photorefractive polymeric material according to any one of claims 32, 34 or 36 to 39 wherein the photosensitive material comprises 2, 4, 7-trinitro–9-fluorenone (TNF).

41. A photorefractive polymeric material according to any one of claims 34 to 40 wherein the plasticiser comprises *N*-ethylcarbazole (ECZ).

42. A photorefractive polymeric material for use in a method of erasable/rewritable optical data storage comprising the following materials:

poly(*N*-vinylcarbazole) (PVK);
2,5, dimethyl-4-(p-nitrophenylazo) anisole (DMNPAA)
2,4,7-trinitro-9-fluorenone (TNF); and
N-ethylcarbazole (ECZ).

43. A photorefractive material according to claim 42 wherein the PVK;DMNPAA;TNF and ECZ are present in approximately the following concentrations by percentage weight of the total weight of the photorefractive material 33:50:1:16.

44. A photorefractive polymeric material for use in a method of optical data storage comprising the following materials:

poly (methyl methacrylate) (PMMA);
2, 5, dimethyl-4-(p-nitrophenylazo) anisole (DMNPAA);
2,4,7-trinitro-9-fluorenone (TNF); and
N-ethylcarbazole (ECZ).

45. A photorefractive polymeric material according to claim 44 wherein the PMMA: DMNPAA; TNF and ECZ are present in approximately the following concentrations by percentage weight of the total weight of the photorefractive polymeric material 73:10:1:16.